

The documentation and process conversion measures necessary to comply with this revision shall be completed by 1 August 2012.

INCH-POUND

MIL-PRF-19500/744C
 1 May 2012
 SUPERSEDING
 MIL-PRF-19500/744B
 9 May 2011

PERFORMANCE SPECIFICATION SHEET

* SEMICONDUCTOR DEVICE, FIELD EFFECT TRANSISTOR, N-CHANNEL, RADIATION HARDENED (TOTAL DOSE AND SINGLE EVENT EFFECTS), LOGIC-LEVEL SILICON, TYPES 2N7616UB, 2N7616UBC, 2N7616UBN, 2N7616UBCN, JANTXVR, JANTXVF, JANSR, AND JANSF

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the product described herein shall consist of this specification sheet and [MIL-PRF-19500](#).

1. SCOPE

* 1.1 Scope. This specification covers the performance requirements for a N-channel, enhancement-mode, radiation hardened (total dose and single event effects (SEE)), low-threshold logic level, MOSFET, transistor. Two levels of product assurance are provided for each device type as specified in [MIL-PRF-19500](#), with avalanche energy maximum rating (E_{AS}) and maximum avalanche current (I_{AS}). See 6.5 for JANHC and JANKC die versions.

1.2 Physical dimensions. See [figure 1](#), UB (metal lid, as shield, connected to fourth pad), UBC (ceramic lid, braze-ring connected to fourth pad), UBN (3-pin, isolated metal lid), and UBCN (3-pin, isolated ceramic lid).

1.3 Maximum ratings. Unless otherwise specified, $T_A = +25^\circ\text{C}$.

Type	P_T $T_A = +25^\circ\text{C}$ (1)	P_T (infinite sink) $T_{IS} = +25^\circ\text{C}$	$R_{\theta JA}$ (2)	V_{DS}	V_{GS}	I_{D1} $T_C = +25^\circ\text{C}$ (3) (4)	I_{D2} $T_C = +100^\circ\text{C}$ (3) (4)	I_S	I_{DM} (5)	T_J and T_{STG}
	<u>W</u>	<u>W</u>	<u>°C/W</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>A dc</u>	<u>A (pk)</u>	<u>°C</u>
2N7616UB, UBC, UBN, UBCN	0.62	1.25	200	60	±10	0.8	0.5	0.8	3.2	-55 to +150

- (1) Derate linearly by 4.5 mW/°C for $T_A > +25^\circ\text{C}$
- (2) See [figure 2](#), thermal impedance curves.
- (3) The following formula derives the maximum theoretical I_D limit:

$$I_D = \sqrt{\frac{T_{JM} - T_C}{(R_{\theta JC}) \times (R_{DS(on)} \text{ at } T_{JM})}}$$

- (4) See [figure 3](#), maximum drain current graph.
- (5) $I_{DM} = 4 \times I_{D1}$ as calculated in note (3).

Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.daps.dla.mil/>.

1.4 Maximum ratings. Unless otherwise specified, $T_C = +25^\circ\text{C}$.

Type	Min $V_{(BR)} DSS$ $V_{GS} = 0\text{ V}$ $I_D = 250\ \mu\text{A dc}$	$V_{GS} (th)1$ $V_{DS} = V_{GS}$ $I_D = 250\ \mu\text{A dc}$	Max I_{DSS1} $V_{GS} = 0\text{ V}$ $V_{DS} = 80\%$ rated VDS	Max $r_{DS(on)}$ (1)		E_{AS}	I_{AS}
				$V_{GS} = 4.5\text{ V dc}$ at I_{D2} $T_J = +25^\circ\text{C}$ $T_J = +150^\circ\text{C}$			
	<u>V dc</u>	<u>V dc</u> <u>Min</u> <u>Max</u>	<u>$\mu\text{A dc}$</u>	<u>Ohm</u>	<u>Ohm</u>	<u>mJ</u>	<u>A dc</u>
2N7616UB UBC, UBN, UBCN	60	1.0 2.0	1.0	0.680	1.020	26.6	1.0

(1) Pulsed (see 4.5.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

[MIL-PRF-19500](#) - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

[MIL-STD-750](#) - Test Methods for Semiconductor Devices.

(Copies of these documents are available online at <https://assist.daps.dla.mil/quicksearch/> or <https://assist.daps.dla.mil/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

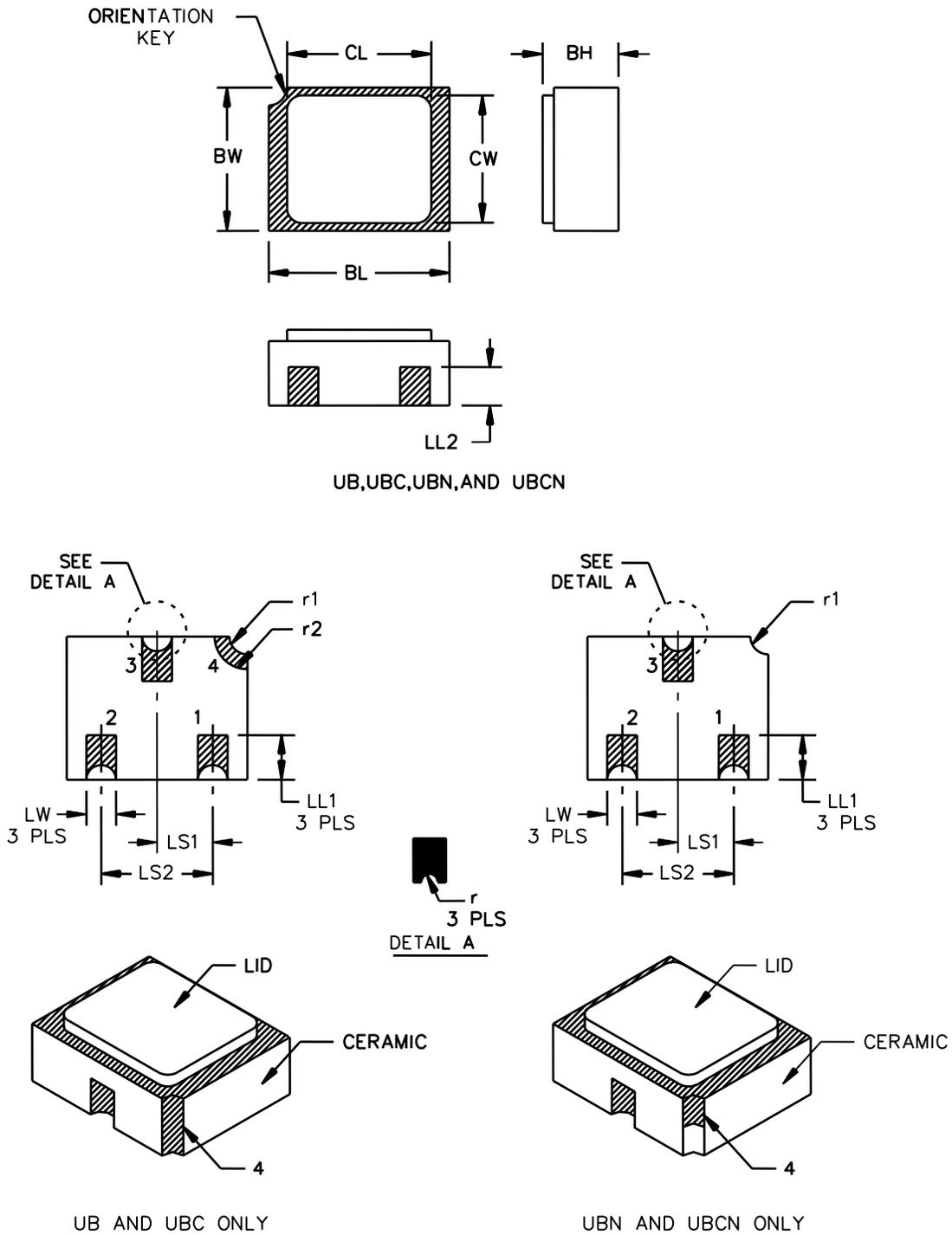


FIGURE 1. Physical dimensions, surface mount (UB, UBN, UBC and UBCN versions).

Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
BL	.115	.128	2.92	3.25	
BW	.095	.108	2.41	2.74	
BH	.046	.056	1.17	1.42	UB only, 4
BH	.046	.056	1.17	1.42	UBN only, 5
BH	.055	.069	1.40	1.75	UBC only, 6
BH	.055	.069	1.40	1.75	UBCN only, 7
CL		.128		3.25	
CW		.108		2.74	
LL1	.022	.038	0.56	0.97	3 PLS
LL2	.014		0.356		3 PLS
LS ₁	.035	.039	0.89	0.99	
LS ₂	.071	.079	1.80	2.01	
LW	.016	.024	0.41	0.61	
r		.008		0.20	6
r1		.012		0.30	8
r2		.022		0.56	UB & UBC only, 8

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Hatched areas on package denote metallized areas.
4. UB only: Pad 1 = Gate, Pad 2 = Source, Pad 3 = Drain, Pad 4 = Shielding connected to the metal lid.
5. UBN only: Pad 1 = Gate, Pad 2 = Source, Pad 3 = Drain, Isolated lid with 3 pads only.
6. UBC (ceramic lid) only: Pad 1 = Gate, Pad 2 = Source, Pad 3 = Drain, Pad 4 = Connected to the lid braze ring.
7. UBCN (ceramic lid) only: Pad 1 = Gate, Pad 2 = Source, Pad 3 = Drain, Isolated lid with 3 pads only.
8. For design reference only.
9. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions, surface mount (UB, UBN, UBC and UBCN versions) - Continued.

3. REQUIREMENTS

3.1 General. The individual item requirements shall be as specified in [MIL-PRF-19500](#) and as modified herein.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list before contract award (see [4.2](#) and [6.3](#)).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in [MIL-PRF-19500](#) and as follows:

I_{AS} Rated avalanche current, nonrepetitive
nC nano Coulomb.

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in [MIL-PRF-19500](#) and [figure 1](#) (UB, UBN, UBC and UBCN) herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with [MIL-PRF-19500](#), [MIL-STD-750](#), and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see [6.2](#)).

3.4.2 Internal construction. Multiple chip construction shall not be permitted.

3.5 Marking. Marking shall be in accordance with [MIL-PRF-19500](#). Marking on the UB package shall consist of an abbreviated part number, the date code, and the manufacturer's symbol or logo. The prefixes JANTXV and JANS can be abbreviated as JV and JS respectively. The "2N" prefix and the "UB" suffix can also be omitted. The radiation hardened designator R, F, G, or H shall immediately precede (or replace) the device "2N" identifier (depending upon degree of abbreviation required).

3.6 Electrostatic discharge protection. The devices covered by this specification require electrostatic protection.

3.6.1 Handling. MOS devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. The following handling practices shall be followed:

- a. Devices shall be handled on benches with conductive handling devices.
- b. Ground test equipment, tools, and personnel handling devices.
- c. Do not handle devices by the leads.
- d. Store devices in conductive foam or carriers.
- e. Avoid use of plastic, rubber, or silk in MOS areas.
- f. Maintain relative humidity above 50 percent if practical.
- g. Care shall be exercised, during test and troubleshooting, to apply not more than maximum rated voltage to any lead.
- h. Gate must be terminated to source, $R \leq 100 \text{ k}\Omega$, whenever bias voltage is to be applied drain to source.

3.7 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in [1.3](#), [1.4](#), and [table I](#).

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in [table I](#) herein.

3.9 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of Inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4 and tables I, II, and III).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not request the performance of table III tests, the tests specified in table III herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

4.2.1.1 SEE. Design capability shall be tested on the initial qualification and thereafter whenever a major die design or process change is introduced (see table III). End-point measurements shall be in accordance with table II.

4.3 Screening (JANS and JANTXV levels only). Screening shall be in accordance with table E-IV of MIL-PRF-19500 and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table E-IV of MIL-PRF-19500) (1) (2)	Measurement	
	JANS	JANTXV
(3)	Gate stress test (see 4.3.1)	Gate stress test (see 4.3.1)
(3)	Method 3470 of MIL-STD-750, E _{AS} (see 4.3.2)	Method 3470 of MIL-STD-750, E _{AS} (see 4.3.2)
(3) 3c	Method 3161 of MIL-STD-750, thermal impedance, (see 4.3.3)	Method 3161 of MIL-STD-750, thermal impedance, (see 4.3.3)
9	Subgroup 2 of table I herein I _{DSS1} , I _{GSSF1} , I _{GSSR1} as minimum	Not applicable
10	Method 1042 of MIL-STD-750, test condition B	Method 1042 of MIL-STD-750, test condition B
11	I _{GSSF1} , I _{GSSR1} , I _{DSS1} , r _{DS(ON)1} , V _{GS(TH)1} Subgroup 2 of table I herein. ΔI _{GSSF1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{DSS1} = ±0.2 μA dc or ±100 percent of initial value, whichever is greater.	I _{GSSF1} , I _{GSSR1} , I _{DSS1} , r _{DS(ON)1} , V _{GS(TH)1} Subgroup 2 of table I herein.
12	Method 1042 of MIL-STD-750, test condition A	Method 1042 of MIL-STD-750, test condition A
13	Subgroups 2 and 3 of table I herein ΔI _{GSSF1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{DSS1} = ±0.2 μA dc or ±100 percent of initial value, whichever is greater. Δr _{DS(ON)1} = ±20 percent of initial value. ΔV _{GS(TH)1} = ±20 percent of initial value.	Subgroup 2 of table I herein ΔI _{GSSF1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{GSSR1} = ±20 nA dc or ±100 percent of initial value, whichever is greater. ΔI _{DSS1} = ±0.2 μA dc or ±100 percent of initial value, whichever is greater. Δr _{DS(ON)1} = ±20 percent of initial value. ΔV _{GS(TH)1} = ±20 percent of initial value.

- (1) At the end of the test program, I_{GSSF1}, I_{GSSR1}, and I_{DSS1} are measured.
- (2) An out-of-family program to characterize I_{GSSF1}, I_{GSSR1}, I_{DSS1}, and V_{GS(th)1} shall be invoked.
- (3) Shall be performed anytime after temperature cycling, screen 3a. JANTXV level does not need to be repeated in screening requirements.

4.3.1 Gate stress test. Apply $V_{GS} = 15$ V minimum for $t = 250$ μ s minimum.

4.3.2 Single pulse avalanche energy (E_{AS}).

- a. Peak current (I_{AS})..... 1.0 A.
- b. Peak gate voltage (V_{GS})..... 10 V dc (up to max rated V_{GS}).
- c. Gate to source resistor (R_{GS})..... $25 \leq R_{GS} \leq 200 \Omega$.
- d. Initial case temperature +25°C, +10°C, -5°C.
- e. Inductance: $\left[\frac{2E_{AS}}{(I_{DI})^2} \right] \left[\frac{V_{BR} - V_{DD}}{V_{BR}} \right]$ mH minimum.
- f. Number of pulses to be applied 1 pulse minimum.
- g. Supply voltage (V_{DD})..... 25 V dc (up to max V_{DS}).

4.3.3 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3161 of [MIL-STD-750](#) using the guidelines in that method for determining I_M , I_H , t_H , t_{SW} , (and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μ s max. See [table III](#), group E, subgroup 4 herein.

* 4.4 Conformance inspection. Conformance inspection shall be in accordance with [MIL-PRF-19500](#).

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with [MIL-PRF-19500](#) and [table I](#) herein. Electrical measurements (end-points) shall be in accordance with the inspections of [table I](#) herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VIA (JANS) and table E-VIB (JANTXV) of [MIL-PRF-19500](#), and herein. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein.

4.4.2.1 Group B inspection, table E-VIA (JANS) of [MIL-PRF-19500](#).

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1051	Test condition G, 100 cycles.
B3	2077	SEM.
B5	1042	Accelerated steady-state gate bias, condition B, $V_{GS} =$ rated V_{GS} ; $T_A = +175^\circ\text{C}$, $t = 24$ hours minimum; or $T_A = +150^\circ\text{C}$, $t = 48$ hours minimum.
B5	1042	Accelerated steady-state reverse bias, condition A, $V_{DS} =$ rated V_{DS} ; $T_A = +175^\circ\text{C}$, $t = 120$ hours minimum; or $T_A = +150^\circ\text{C}$, $t = 240$ hours minimum.
B5	2037	Test condition D.

* 4.4.2.2 Group B inspection, table E-VIB (JANTXV) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	1051	Test condition C, 25 cycles.

* B3 1042 Intermittent operation life, condition D, 2,000 cycles.

* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VII of [MIL-PRF-19500](#) and as follows. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Terminal strength is not applicable.

C5 3161 See [4.3.3](#), $R_{\theta JA}$ = (see [1.3](#)).

* C6 1042 Intermittent operation life, condition D, 6,000 cycles.

4.4.4 Group D inspection. Group D inspection shall be conducted in accordance with table E-VIII of [MIL-PRF-19500](#) and [table II](#) herein.

4.4.5 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of [MIL-PRF-19500](#) and as specified in [table III](#) herein. Electrical measurements (end-points) shall be in accordance with [table I](#), subgroup 2 herein.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of [MIL-STD-750](#).

MIL-PRF-19500/744C

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance <u>2/</u>	3161	See 4.3.3	$Z_{\theta JA}$			°C/W
Breakdown voltage drain to source	3407	$V_{GS} = 0$, $I_D = 250 \mu A$ dc, bias condition C	$V_{(BR)DSS}$	60		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$, $I_D = 250 \mu A$ dc	$V_{GS(TH)1}$	1.0	2.0	V dc
Gate current	3411	$V_{GS} = +10$ V dc, bias condition C, $V_{DS} = 0$	I_{GSSF1}		+100	nA dc
Gate current	3411	$V_{GS} = -10$ V dc, bias condition C, $V_{DS} = 0$	I_{GSSR1}		-100	nA dc
Drain current	3413	$V_{GS} = 0$, bias condition C, $V_{DS} = 80$ percent of rated V_{DS}	I_{DSS1}		1.0	μA dc
Static drain to source on-state resistance	3421	$V_{GS} = 4.5$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)1}$		0.680	Ω
Forward voltage	4011	$V_{GS} = 0$, condition A, pulsed (see 4.5.1), $I_D = I_{D1}$	V_{SD}		1.2	V (pk)
<u>Subgroup 3</u>						
High temperature operation:		$T_C = T_J = +125^\circ C$				
Gate current	3411	$V_{GS} = \pm 10$ V dc, bias condition C, $V_{DS} = 0$	I_{GSS2}		± 200	nA dc
Drain current	3413	$V_{GS} = 0$, bias condition C, $V_{DS} = 80$ percent of rated V_{DS}	I_{DSS2}		10	μA dc
Static drain to source on-state resistance	3421	$V_{GS} = 4.5$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(ON)2}$		0.980	Ω
Gate to source voltage (threshold)	3403	$V_{DS} = V_{GS}$, $I_D = 250 \mu A$ dc	$V_{GS(TH)2}$	0.5		V dc

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
<u>Subgroup 3</u> – Continued.						
Low temperature operation:		$T_C = T_J = -55^\circ\text{C}$				
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}, I_D = 250 \mu\text{A dc}$	$V_{GS(\text{TH})3}$		2.5	V dc
<u>Subgroup 4</u>						
Forward transconductance	3475	$V_{DS} = 10 \text{ V dc}, I_D = I_{D2}, \text{pulsed (see 4.5.1)}$	g_{FS}	0.23		S
Gate series resistance	3402	Condition B	R_G		14	Ω
<u>Subgroup 5</u>						
Safe operating area test	3474	$V_{DS} = 80 \text{ percent of rated } V_{DS} \text{ (see 1.3); } t_P = 10 \text{ ms}, I_D \text{ as specified on figure 4}$				
Electrical measurements		See table I , subgroup 2				
<u>Subgroups 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Gate charge	3471	Condition B, $I_D = I_{D1}, V_{DD} = 50 \text{ percent rated } V_{DS}$				
On-state gate charge			$Q_{G(\text{on})}$		3.6	nC
On gate to source charge			Q_{GS1}		1.5	nC
On gate to drain charge			Q_{GD1}		1.8	nC
Turn-off gate charge			$Q_{G(\text{off})}$		3.6	nC
Off gate to source charge			Q_{GS2}		1.5	nC
Off gate to drain charge			Q_{GD2}		1.8	nC
Reverse recovery time	3473	$di/dt = -100 \text{ A}/\mu\text{s}, V_{DD} \leq 25 \text{ V}, I_D = I_{D1}$	t_{rr}		78	ns

1/ For sampling plan, see [MIL-PRF-19500](#).

2/ This test required for the following end-point measurements only:

- Group B, subgroups 3 and 4 (JANS).
- Group B, subgroups 2 and 3 (JANTXV).
- Group C, subgroup 2 and 6.
- Group E, subgroup 1.

TABLE II. Group D inspection.

Inspection <u>1/ 2/ 3/</u>	MIL-STD-750		Symbol	Pre-irradiation limits		Post-irradiation limits		Post-irradiation limits		Unit
	Method	Conditions		R and F		R		F		
				Min	Max	Min	Max	Min	Max	
<u>Subgroup 1</u>										
Not applicable										
<u>Subgroup 2</u>		$T_C = + 25^\circ\text{C}$								
Steady-state total dose irradiation (V_{GS} bias) <u>4/</u>	1019	$V_{GS} = 10\text{ V};$ $V_{DS} = 0$								
Steady-state total dose irradiation (V_{DS} bias) <u>4/</u>	1019	$V_{GS} = 0;$ $V_{DS} = 80$ percent of rated V_{DS} (pre-irradiation)								
End-point electricals:										
Breakdown voltage, drain to source	3407	$V_{GS} = 0; I_D = 250\ \mu\text{A};$ bias condition C	$V_{(BR)DSS}$	60		60		60		V dc
Gate to source voltage (threshold)	3403	$V_{DS} \geq V_{GS}$ $I_D = 250\ \mu\text{A}$	$V_{GS(th)1}$	1.0	2.0	1.0	2.0	1.0	2.0	V dc
Gate current	3411	$V_{GS} = +10\text{ V}, V_{DS} = 0,$ bias condition C	I_{GSSF1}		100		100		100	nA dc
Gate current	3411	$V_{GS} = -10\text{ V}, V_{DS} = 0,$ bias condition C	I_{GSSR1}		-100		-100		-100	nA dc
Drain current	3413	$V_{GS} = 0,$ bias condition C; $V_{DS} = 80$ percent of rated V_{DS} (pre-irradiation)	I_{DSS}		1.0		1.0		1.0	μA dc
Static drain to source on-state voltage	3405	$V_{GS} = 4.5\text{ V};$ condition A, pulsed (see 4.5.1), $I_{D1} = I_{D2}$	$V_{DS(on)}$		0.275		0.275		0.275	V dc
Forward voltage source drain diode	4011	$V_{GS} = 0; I_D = I_{D1}$ bias condition C	V_{SD}		1.2		1.2		1.2	V dc

1/ For sampling plan see MIL-PRF-19500.

2/ Group D qualification may be performed prior to lot formation. Wafers qualified to these group D QCI requirements may be used for any other specification sheets utilizing the same die design.

3/ At the manufacturer's option, group D samples need not be subjected to the screening tests, and may be assembled in its qualified package or in any qualified package that the manufacturer has data to correlate the performance to the designated package.

4/ Separate samples shall be pulled for each bias.

TABLE III. Group E inspection (all quality levels) - for qualification or re-qualification only.

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling	1051	Condition G, 500 cycles	
Hermetic seal	1071		
Fine leak			
Gross leak			
Electrical measurements		See table I , subgroup 2	
<u>Subgroup 2 1/</u>			45 devices c = 0
Steady-state gate bias	1042	Condition B, 1,000 hours	
Electrical measurements		See table I , subgroup 2	
Steady-state reverse bias	1042	Condition A, 1,000 hours	
Electrical measurements		See table I , subgroup 2	
<u>Subgroup 3</u>			45 devices c = 0
Switching time test	3472	$I_D = I_{D1}$, $V_{GS} = 5.0$ V dc, $R_G = 24\Omega$, $V_{DD} = 50$ percent rated V_{DS} Maximum measurements: $t_{d(on)} = 8$ ns; $t_r = 24$ ns; $t_{d(off)} = 30$ ns; $t_f = 13$ ns	
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance curves	3161	See MIL-PRF-19500 .	
<u>Subgroup 10</u>			22 devices c = 0
Commutating diode for safe operating area test procedure for measuring dv/dt during reverse recovery of power MOSFET transistors or insulated gate bipolar transistors	3476	Test conditions shall be derived by the manufacturer.	

See footnotes at end of table.

TABLE III. Group E inspection (all quality levels) for qualification or re-qualification only - Continued.

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
<u>Subgroup 11</u> SEE <u>2/ 3/ 4/</u> Electrical measurements <u>5/</u> SEE irradiation Electrical measurements <u>5/</u>	1080	See figure 5 I_{GSSF1} , I_{GSSR1} , and I_{DSS1} in accordance with table I , subgroup 2 Fluence = $3E5 \pm 20$ percent ions/cm ² Flux = $2E3$ to $2E4$ ions/cm ² /sec, temperature = $25^{\circ} \pm 5$ °C Surface LET = $38 \text{ MeV-cm}^2/\text{mg} \pm 5.0\%$, range = $38 \mu\text{m} \pm 7.5\%$, energy = $300 \text{ MeV} \pm 7.5\%$ (nominal 3.86 MeV/nucleon at Brookhaven National Lab Accelerator) In-situ bias conditions: $V_{DS} = 60 \text{ V}$ and $V_{GS} = -6 \text{ V}$ $V_{DS} = 35 \text{ V}$ and $V_{GS} = -7 \text{ V}$ Surface LET = $62 \text{ MeV-cm}^2/\text{mg} \pm 5.0\%$, range = $33 \mu\text{m} \pm 7.5\%$, energy = $355 \text{ MeV} \pm 7.5\%$ (nominal 2.92 MeV/nucleon at Brookhaven National Lab Accelerator) In-situ bias conditions: $V_{DS} = 60 \text{ V}$ and $V_{GS} = -5 \text{ V}$ $V_{DS} = 30 \text{ V}$ and $V_{GS} = -6 \text{ V}$ Surface LET = $85 \text{ MeV-cm}^2/\text{mg} \pm 5\%$, range = $29 \mu\text{m} \pm 7.5\%$, energy = $380 \text{ MeV} \pm 10\%$ (nominal 1.98 MeV/nucleon at Brookhaven National Lab Accelerator) In-situ bias conditions: $V_{DS} = 60 \text{ V}$ and $V_{GS} = -4 \text{ V}$ $V_{DS} = 40 \text{ V}$ and $V_{GS} = -5 \text{ V}$	3 devices

1/ A separate sample for each test shall be pulled.

2/ Group E qualification of SEE effect testing may be performed prior to lot formation. Qualification may be extended to other specification sheets utilizing the same structurally identical die design.

3/ Device qualification to a higher level LET is sufficient to qualify all lower level LETs.

4/ The sampling plan applies to each bias condition.

5/ Examine I_{GSSF1} , I_{GSSR1} , and I_{DSS1} before and following SEE irradiation to determine acceptability for each bias condition. Other test conditions in accordance with [table I](#), subgroup 2, may be performed at the manufacturer's option.

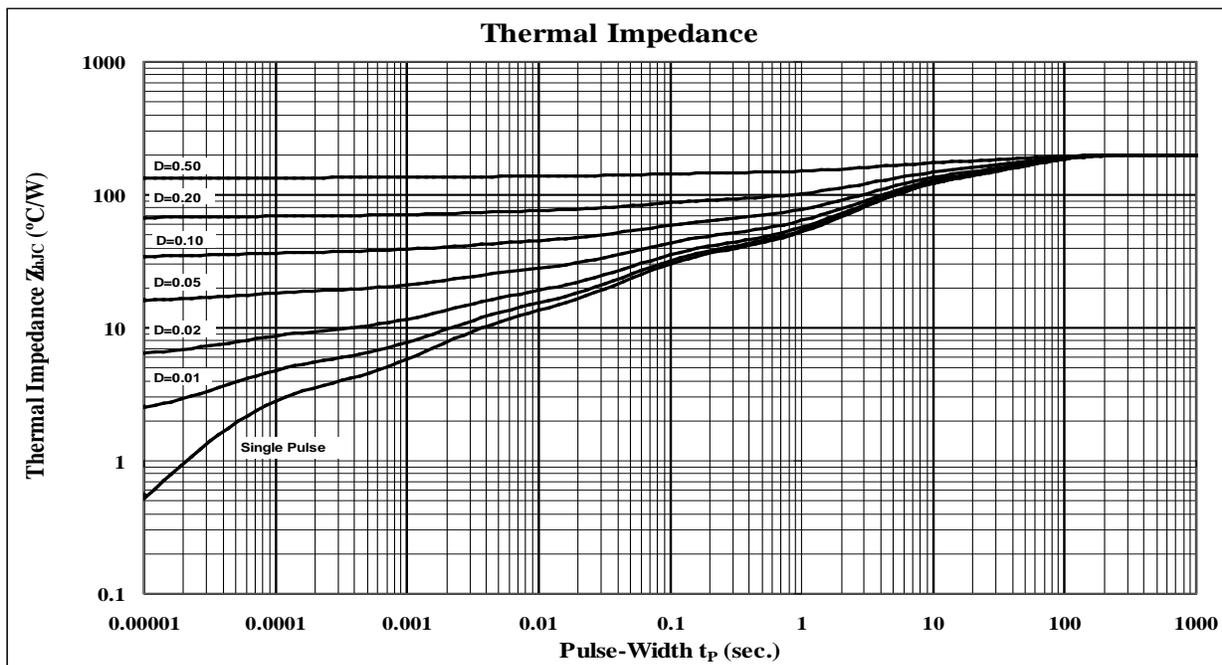


FIGURE 2. Thermal impedance graph.

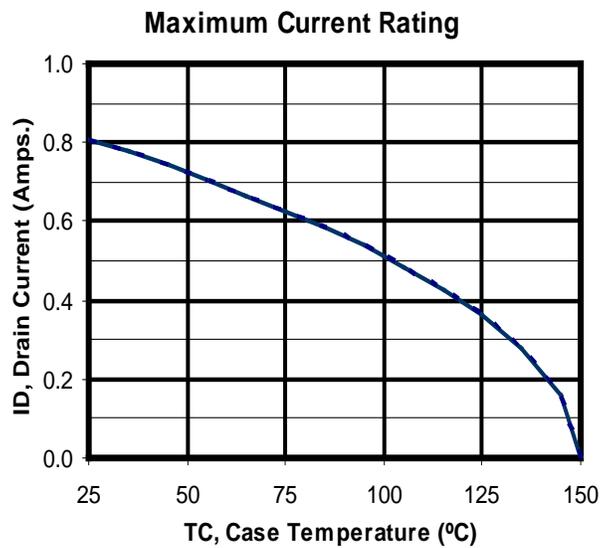


FIGURE 3. Derating drain current.

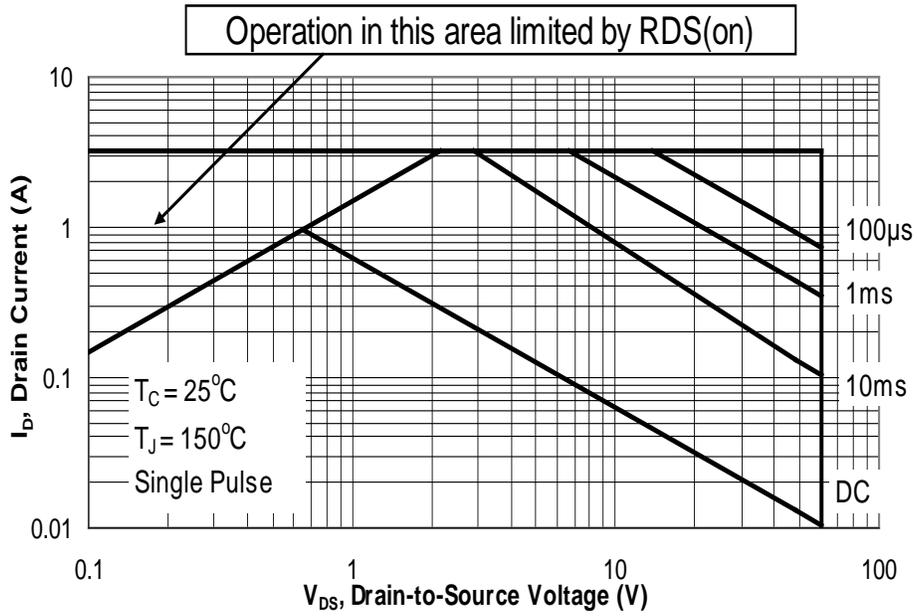


FIGURE 4. Safe-operating-area graph.

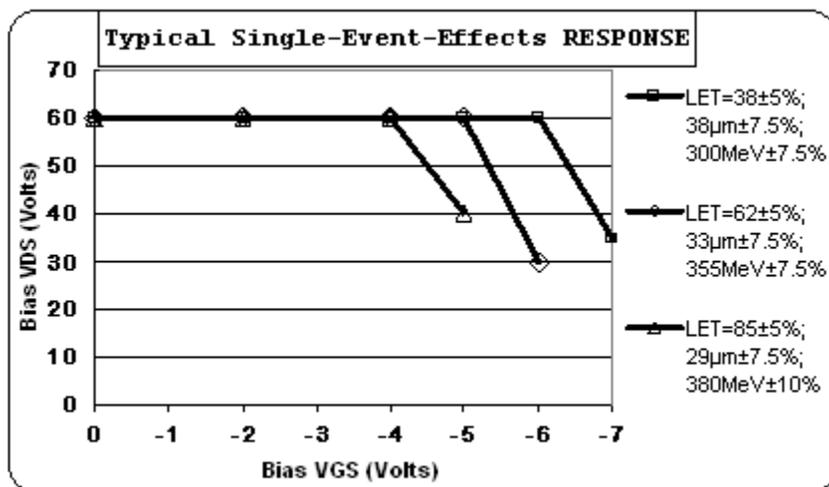


FIGURE 5. Typical SEE safe-operating-area graph.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory. The notes specified in [MIL-PRF-19500](#) are applicable to this specification.)

6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Packaging requirements (see 5.1).
- c. Lead finish (see 3.4.1).
- d. Product assurance level and type designator.
- * e. For acquisition of RHA designated devices, [table II](#), subgroup 1 testing of group D herein is optional. If subgroup 1 is desired, it must be specified in the contract.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML 19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.daps.dla.mil>.

6.4 JANC die versions. The JANHC and JANKC die versions of these devices are covered under specification sheet [MIL-PRF-19500/741](#).

6.5 Cross-reference list. The following table shows the generic P/N and its associated military P/N (without JAN and RHA prefix).

Generic P/N	Military P/N	Package & Termination Configuration
IRHLUB770Z4	2N7616UB	4-pad, Metal Lid (Shield) connected to 4 th pad
IRHLUBN770Z4	2N7616UBN	3-pad, Isolated Metal Lid
IRHLUBC770Z4	2N7616UBC	4-pad, Ceramic Lid, lid braze ring connected to 4th pad
IRHLUBCN770Z4	2N7616UBCN	3-pad, Isolated Ceramic Lid

6.6 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
 Army - CR
 Navy - EC
 Air Force - 85
 NASA - NA
 DLA - CC

Preparing activity:
 DLA - CC
 (Project 5961-2011-078)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.daps.dla.mil>.